15036.00

transpogroup
WHAT TRANSPORTATION CAN BE.

Inneswood Apartments

TRANSPORTATION IMPACT ANALYSIS

855 Newport Way NW
Issaquah, WA 98027

December 2015

Prepared for
Inneswood Estates, LLC

Prepared by
Ryan Peterson,
Senior Transportation Engineer, PE, PTOE
Transpo Group
11730 118th Ave NE Suite 600
Kirkland, WA 98034

INNESWOOD APARTMENTS

Parcel B: 905 Newport Way NW, Issaquah, WA 98027
Parcel C: 843 Newport Way NW, Issaquah, WA 98027

Application Number:
Applicant's Name: Inneswood Estates, LLC.
Applicant's Address: P.O. Box 617, Bellevue, WA 98008
Applicant's Phone Number: 206 714-7161
Original Report Date: December 2, 2015
Revised Report Date: N/A

Prepared by:
Ryan Peterson, Senior Transportation Engineer, PE, PTOE,

11730 118th Avenue NE, Suite 600
Kirkland, WA 98034-7120
Phone: 425-821-3665
Fax: 425-825-8434
www.transpogroup.com

Table of Contents

Appendix

Figures

Tables

Executive Summary

This section provides an executive summary of the Transportation Impact Analysis through a set of frequently asked questions (FAQs).

Where is the project located and what would be developed?

The project is located along the west side of the Newport Way NW/NW Juniper Street intersection in Issaquah. The development would include the construction of 81 apartment units and 12 townhome units through two buildings, Building B in Parcel B, and Building C in Parcel C.

What existing public streets will serve the project and where is access proposed?

Newport Way NW, Maple Street NW, NW Juniper Street, and NW Gilman Boulevard are primary roadways within the surrounding area and all would serve project traffic. Site access is proposed via driveways on Newport Way NW.

Is the site currently served by public transit?

King County Metro currently operates 5 routes in the area, and Sound Transit currently operates 3 routes in the area. The closest transit stops are east of the site at the NW Gilman Blvd/NW Juniper Street intersection, approximately 0.5 miles (or an 8- to 10-minute walk) from the site.

How many new parking spaces are proposed?

The proposed project would provide two parking garages, with 113 stalls in Building B and 8 stalls in Building C, totaling 121 parking stalls.

How many daily vehicular trips would the project generate and when would peak traffic volumes occur?

It is anticipated that the project will generate approximately 674 weekday daily trips with 47 occurring during the weekday AM peak hour and 67 during the PM peak hour.

What Transportation impacts are anticipated, if any?

No impacts are anticipated.

What measures are proposed to reduce or control traffic impacts?

In addition to the construction of frontage improvements, the project is planning to include construction of the City planned roundabout at the Newport Way NW/NW Juniper Street intersection in lieu of paying traffic impact fees.

Introduction

This transportation impact analysis (TIA) identifies potential transportation-related impacts associated with the development of two apartment buildings located west of Newport Way NW, north and south of NW Juniper Street in Issaquah. As necessary, mitigation measures are identified that would offset or reduce significant transportation related impacts that the proposed project may have on the surrounding transportation system.

Project Description

As shown on Figure 1, the proposed project is located west of Newport Way NW, north and south of NW Juniper Street. The development would construct 81 apartment units and 12 townhome units through two buildings. Building C is located south of NW Juniper Street and would contain 7 apartments units. Building B is located north of NW Juniper Street and would contain 74 apartment units and 12 townhome units. There is an existing single family home on the property that would be demolished as part of the project. Figure 2 illustrates the preliminary site plan.

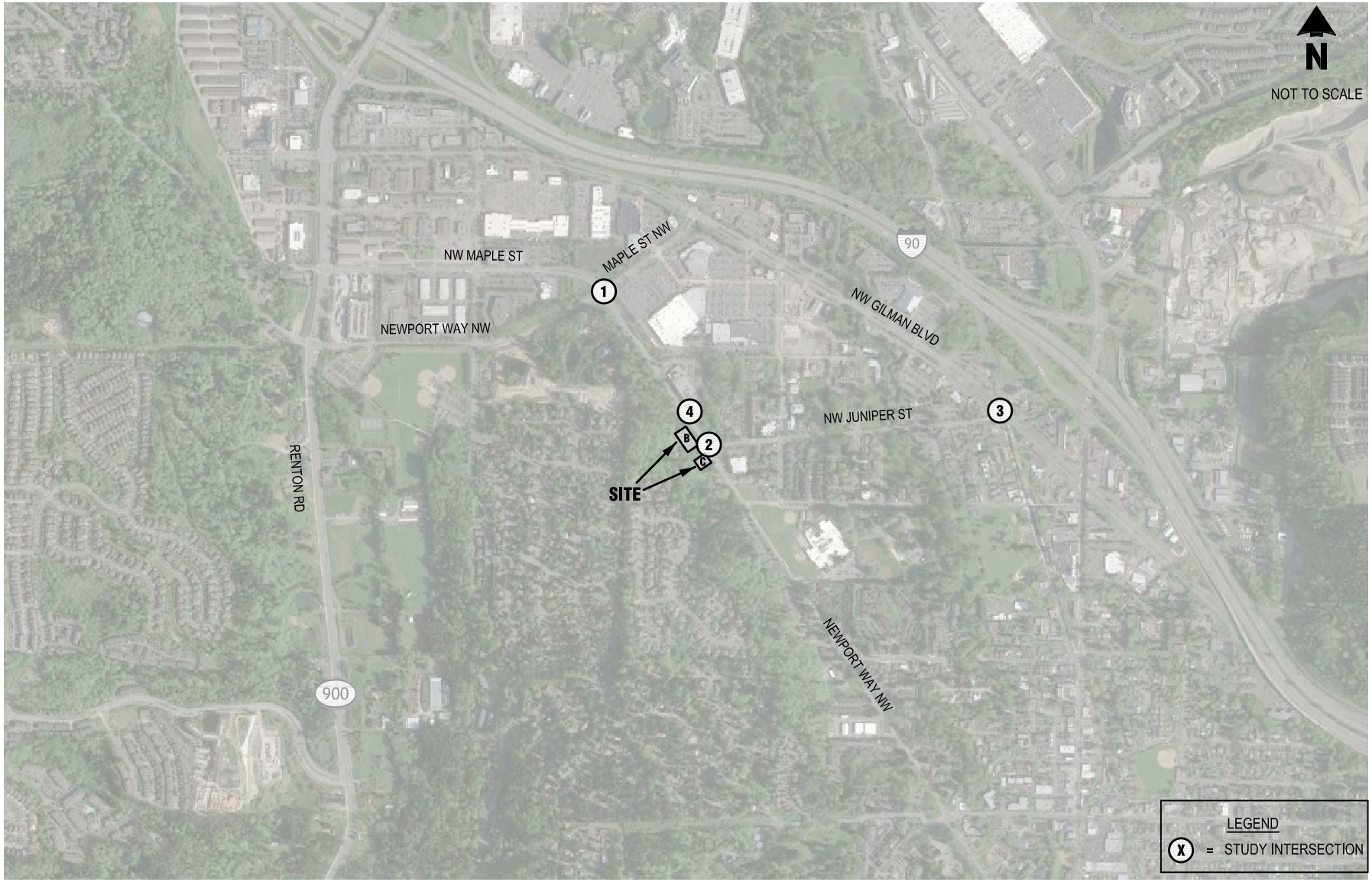
One garage is proposed as part of each building. Building C is anticipated to have 8 stalls, and Building B is anticipated to have 113 stalls, totaling 121 parking stalls. Access to both parking locations is proposed via Newport Way NW. It is anticipated that the development would be constructed and occupied by 2018.

Study Scope

The scope of this analysis was coordinated with the City of Issaquah staff and follows the City's *Transportation Impact Analysis Guidelines*, April 2015. Based on the anticipated trip generation and distribution of the proposed project, the largest impacts would occur immediately adjacent to the project site. The following intersections are proposed for analysis:

- NW Maple Street (Newport Way NW)/Maple Street NW
- Newport Way NW/NW Juniper Street
- NW Gilman Boulevard/NW Juniper Street
- Newport Way NW/Library Access

In addition, the access points along Newport Way NW were evaluated under future (2018) with-project conditions. The study focuses on the weekday PM peak hours when transportation impacts are anticipated to be highest. The report first describes existing and future (2018) without-project conditions in the vicinity of the project site. This includes the street system, existing and future without-project weekday PM peak hour traffic volumes, traffic operations, traffic safety, non-motorized facilities, and transit service. Future (2018) with-project conditions are then described. The project's impacts on the surrounding transportation system were identified by comparing the future with-project conditions to the future without-project conditions.



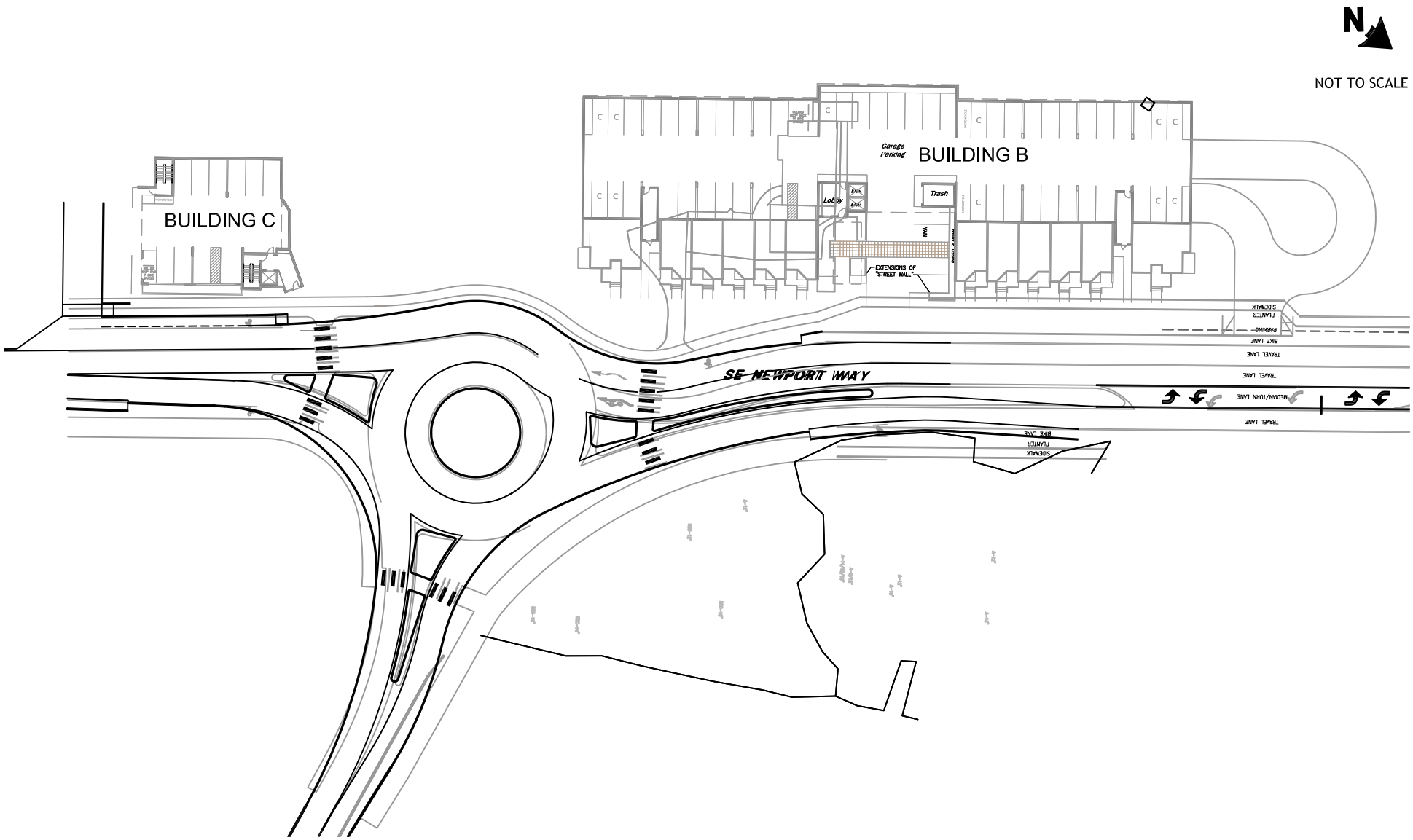
Site Vicinity & Study Intersections

FIGURE 1

Inneswood Apartments

transpogroup
WHAT TRANSPORTATION CAN BE.

Dec 12, 2015 - 7:28am jessical Q:\Projects\15\15036.00 - Inneswood Apts-Newport Road Improvements\Graphics\15036_Graphics.dwg Layout: 1 - Site Vicinity



Preliminary Site Plan

Inneswood Apartments

FIGURE
2

transpogroup
WHAT TRANSPORTATION CAN BE.

Dec 12, 2015 - 7:36am jessical Q:\Projects\15\15036.00 - Inneswood Apts-Newport Road Improvements\Graphics\Graphics_site plan.dwg Layout: Preliminary Site Plan

Existing & Future Without-Project Conditions

This section describes existing (2015) and future (2018) without-project conditions within the study area. Study area characteristics are provided for the street system, planned improvements, existing and future forecasted without-project traffic volumes, traffic operations, traffic safety, non-motorized facilities, and transit service.

Street System

The following describes the existing street network within the vicinity of the proposed project and anticipated changes resulting from planned improvements.

Existing

The project site is located in Issaquah, WA, and is bounded by Newport Way NW to the west. The major roadways within the study area include:

NW Maple Street is an east-west roadway, continuing into Newport Way NW south of Maple Street NW. Classified as a minor arterial, NW Maple Street includes five lanes with a center two-way left-turn lane. On the east end of NW Maple Street, the roadway curves to the southeast and becomes Newport Way NW. Shortly after, the roadway narrows to two lanes. Both the north and south sides of NW Maple Street have landscaped sidewalks. The posted speed along NW Maple Street is 30 miles per hour (mph).

NW Gilman Boulevard is a five-lane roadway classified as a minor arterial with sidewalks and a two-way left turn lane. The two-way left-turn lane allows access to the adjacent Gilman Village and Issaquah Commons retail areas and includes a landscaped center median. The roadway has bike lanes in each direction from its intersection with Maple Street NW heading southeast. The posted speed along NW Gilman Boulevard is 35 mph.

NW Juniper Street is an east-west collector arterial connecting Newport Way NW and NW Gilman Boulevard. The two-lane two-way roadway includes sidewalks on both north and south sides, as well as parallel parking along the south side. The posted speed limit along NW Juniper Street is 25 mph.

Newport Way NW is a two-lane two-way principal arterial with a sidewalk on the east side of the roadway. The roadway connects Maple Street NW and NW Juniper Street and provides direct access to the proposed project site near the NW Juniper Street intersection. The posted speed limit along Newport Way NW is 30 mph. Newport Way NW is also designated as a Parkway in the Central Issaquah Development Standards.

Maple Street NW is a two-way three-lane minor arterial connecting NW Maple Street and NW Gilman Boulevard. Maple Street NW includes a two-way left turn lane throughout, as well as sidewalks on both sides of the roadway. The posted speed limit along Maple Street NW is 25 mph.

Characteristics of the existing roadway network in the proposed project vicinity are shown in Table 1.

Table 1. Study Area Existing Street System Summary

Roadway	Arterial Classification	Posted Speed Limit	Number of Travel Lanes	Parking	Sidewalks	Bicycle Facilities
NW Maple Street	Minor Arterial	30 mph	5	No	Yes	No
NW Gilman Boulevard	Minor Arterial	35 mph	5	No	Yes	Yes[1]
NW Juniper Street	Collector Arterial	25 mph	2	Yes[2]	Yes	No
Newport Way NW	Principal Arterial	30 mph	2	No	Yes[3]	No
Maple Street NW	Minor Arterial	25 mph	3	No	Yes[4]	No

1. Bike lane located south of Maple Street NW.
2. Parallel parking along south side of roadway.
3. Sidewalks are provided intermittently along Newport Way NW.
4. Sidewalks provided east of Newport Way NW.

Future

Based on a review of the *City of Issaquah 2015-2020 Six Year Transportation Improvement Program (TIP)*, no transportation projects that may impact the street system and travel patterns in the study area were identified to be completed by 2018. Although anticipated after completion of the proposed project, safety improvements are planned along NW Gilman Boulevard. In addition, improvements to the NW Maple Street/Newport Way NW intersection and along Newport Way NW are planned to be funded in future years. These include improvements to channelization and traffic flow along Newport Way NW.

Additionally, as part of the proposed project, in lieu of traffic impact fees, the project plans to construct a roundabout at the Newport Way NW/NW Juniper Street intersection.

Traffic Volumes

The following section summarizes traffic volumes for existing (2015) and future (2018) without-project conditions.

Existing

Traffic counts were collected at each study intersection in November 2015. Figure 4 illustrates the existing weekday PM peak hour traffic volumes at the study intersections. Detailed traffic counts are provided in Appendix A.

Future

Future (2018) without-project traffic volumes were forecasted by applying an average annual growth rate to existing traffic volumes as well as traffic from previously approved “pipeline” development projects that would increase background traffic at study intersections. An annual growth rate of 2 percent per year was applied to the existing PM peak hour traffic volumes at each study intersection to estimate future (2018) background traffic. This growth rate is based on discussions with City staff. Traffic from the following pipeline projects in the project vicinity were also included in the future (2018) without-project volume forecasts:

- Atlas – 640 to 755 NW Gilman Boulevard: Includes construction of approximately 343 multifamily apartment units.
- Pickering Hill Plats – 910 11th Place NW: Anticipated to construct 20 single family units.
- Maple Street Marriott – 1185 NW Maple Street: Includes the construction of a 145 room hotel.

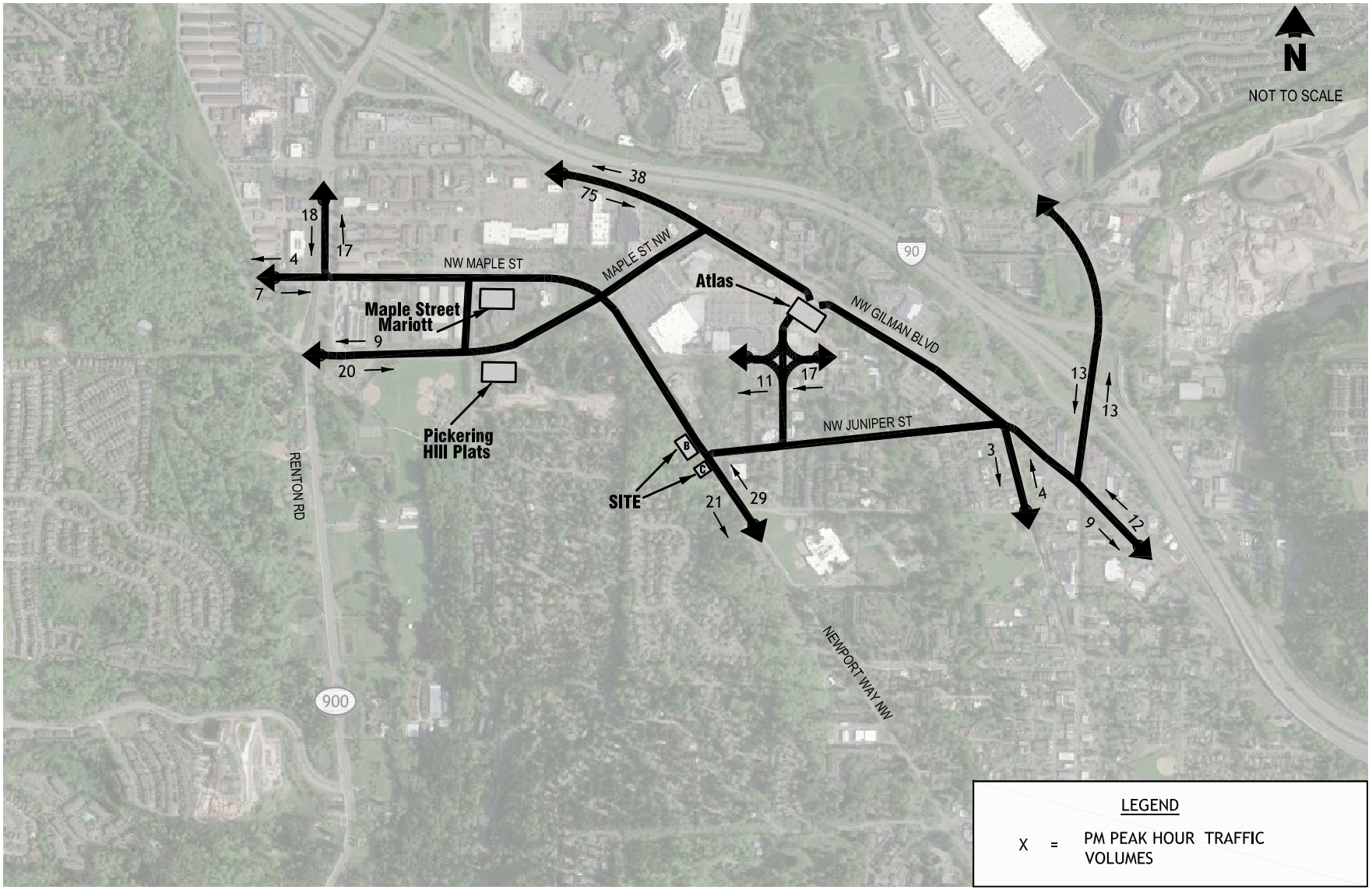
Traffic studies were not available for the above listed developments. As a result, the trip generation was estimated based on the size and type of development. Table 2 below summarizes the estimated trip generation for the pipeline projects. Trips associated with the

residential pipeline developments were assigned to the network following the trip distribution developed for this project from the City's travel demand model (Shown in Figure 6 and Figure 7). A separate trip distribution was developed for the proposed hotel. It is anticipated that the development would be an extended stay hotel and trips would trend more toward Seattle and Redmond via I-90 and E Lake Sammamish Parkway SE. It is estimated that approximately 40 percent would go north along NW Maple Street and Renton Road (SR 900) toward I-90, 15 percent would go south along Renton Road (SR 900), 15 percent would go south along Newport Way NW, and 30 percent would go northbound along E Lake Sammamish Parkway SE. The increase in vehicular volume is shown in Figure 3 in terms of entering/exiting vehicles. Future (2017) without-project volumes, including background and pipeline volumes, are illustrated on Figure 5.

Table 2. Estimated Weekday Pipeline Trip Generation

		PM Peak-Hour Trips			
Land Use	**Size**	**Rate**	**In**	**Out**	**Total**
Proposed					
Maple Street Marriott – Hotel (LU #310)	145 rooms	0.60	44	43	87
Pickering Hills Plats – Residential (LU #210)	20 du	1.00	13	7	20
Atlas – Residential (LU #220)	343 du	0.62	138	75	213

du = dwelling unit



Cumulative Pipeline Trip Assignment

FIGURE
3

Inneswood Apartments

transpogroup
WHAT TRANSPORTATION CAN BE.

Dec 02, 2015 - 1:03pm francescal \\srv-dfs-wa\MM_Projects\Projects\15\15036.00 - Inneswood Apts-Newport Road Improvements\Graphics\15036_Graphics.dwg Layout: 3 - Pipeline Distribution

Traffic Operations

The operational characteristics of an intersection are determined by calculating the intersection level of service (LOS). At signalized intersections, LOS is measured in average control delay per vehicle and is typically reported using the intersection delay and volume-to-capacity ratio (V/C). At stop-sign-controlled intersections, LOS is measured in delay per vehicle. Traffic operations for an intersection can be described alphabetically with a range of levels of service (LOS A through F), with LOS A indicating free-flowing traffic and LOS F indicating extreme congestion and long vehicle delays. Appendix B contains a detailed explanation of LOS criteria and definitions.

Weekday PM peak hour traffic operations for existing (2015) and future (2018) without-project conditions were evaluated at the study intersections based on the procedures identified in the *Highway Capacity Manual (HCM)* (2010), with the exception of one intersection, and were evaluated using the *Synchro 9* software program. The Newport Way NW/NW Maple Street intersection was evaluated utilizing the HCM 2000 methodology based on signal phasing provided by the City. HCM 2010 methodologies utilize National Electrical Manufacturers Association (NEMA) phasing, currently the phasing does not follow NEMA phasing. Consideration could be made to updating signal phasing. Pedestrian and bicycle volumes were taken into account when evaluating the operations of the intersections.

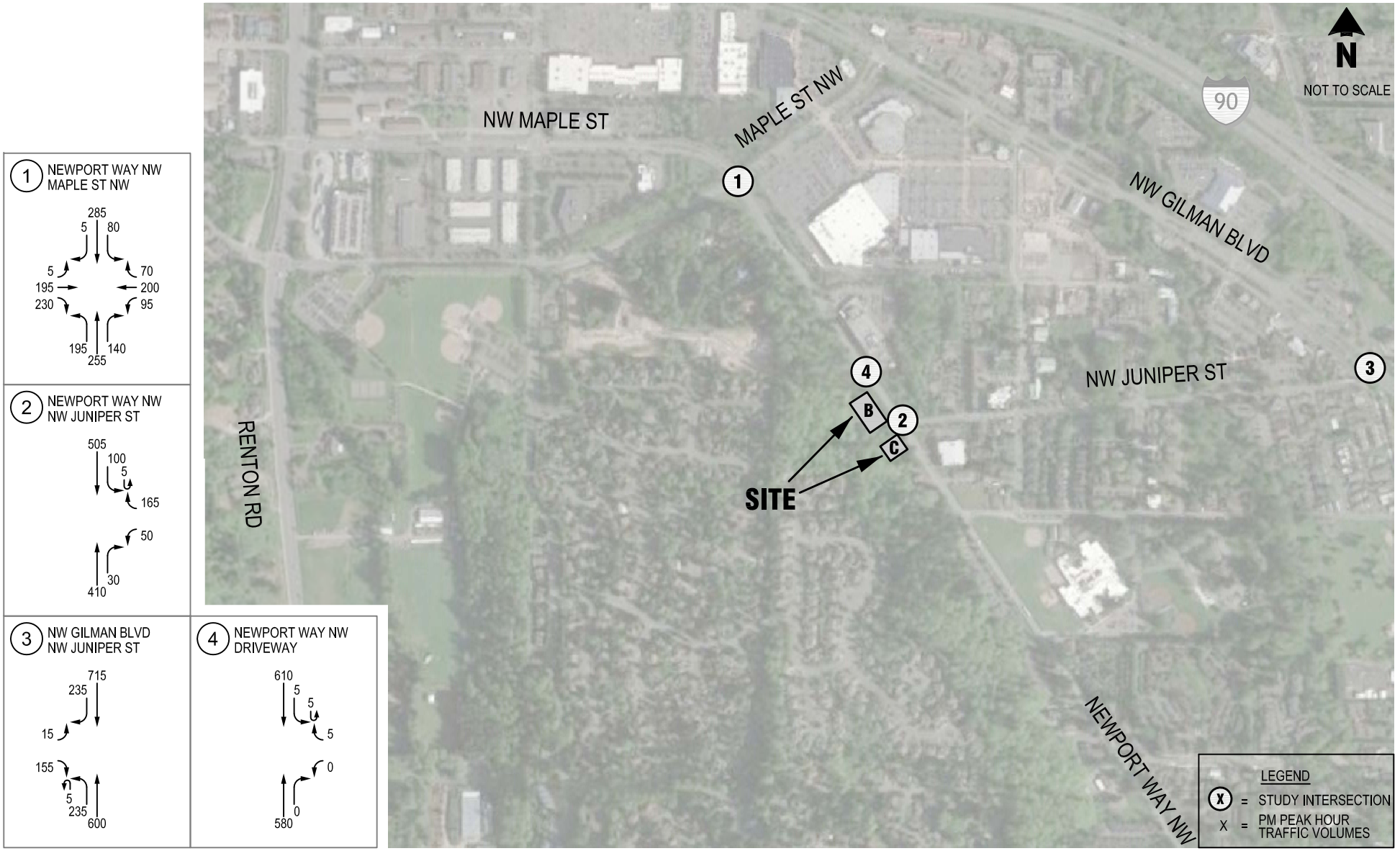
Table 3 summarizes the existing (2015) and future (2018) without-project traffic operations at the study intersections. Detailed LOS worksheets are provided in Appendix C.

Table 3. Existing & Future Weekday PM Peak Hour Intersection LOS Summary

Intersection	Traffic Control	2015 Existing PM			2018 Without-Project PM		
		LOS[1]	Delay[2]	WM[3]	LOS	Delay	WM
1. Newport Way NW/NW Maple Street	Signalized	D	39	-	D	42	-
2. Newport Way NW/NW Juniper Street	Unsignalized	C	24	WB	E	37	WB
3. NW Gilman Boulevard/NW Juniper Street	Unsignalized	C	20	EB	D	25	EB
4. Newport Way NW/Library Access	Unsignalized	B	13	WB	B	13	WB

1. Level of Service (A – F) as defined by the 2010 *Highway Capacity Manual* (HCM), Transportation Research Board.
2. Average delay per vehicle in seconds.
3. WM = Worst Movement reported for unsignalized intersections. NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound.

As shown in Table 3, all study intersections are currently operating at LOS D or better during the weekday PM peak hour. Under future (2018) without-project conditions all study intersections are anticipated to operate at LOS D or better with the exception of the Newport Way NW/NW Juniper Street intersection. The Newport Way NW/NW Juniper Street intersection is anticipated to degrade form LOS C to LOS E and would fall below City of Issaquah standards. The NW Gilman Boulevard/NW Juniper Street intersection is anticipated to degrade from LOS C to LOS D.



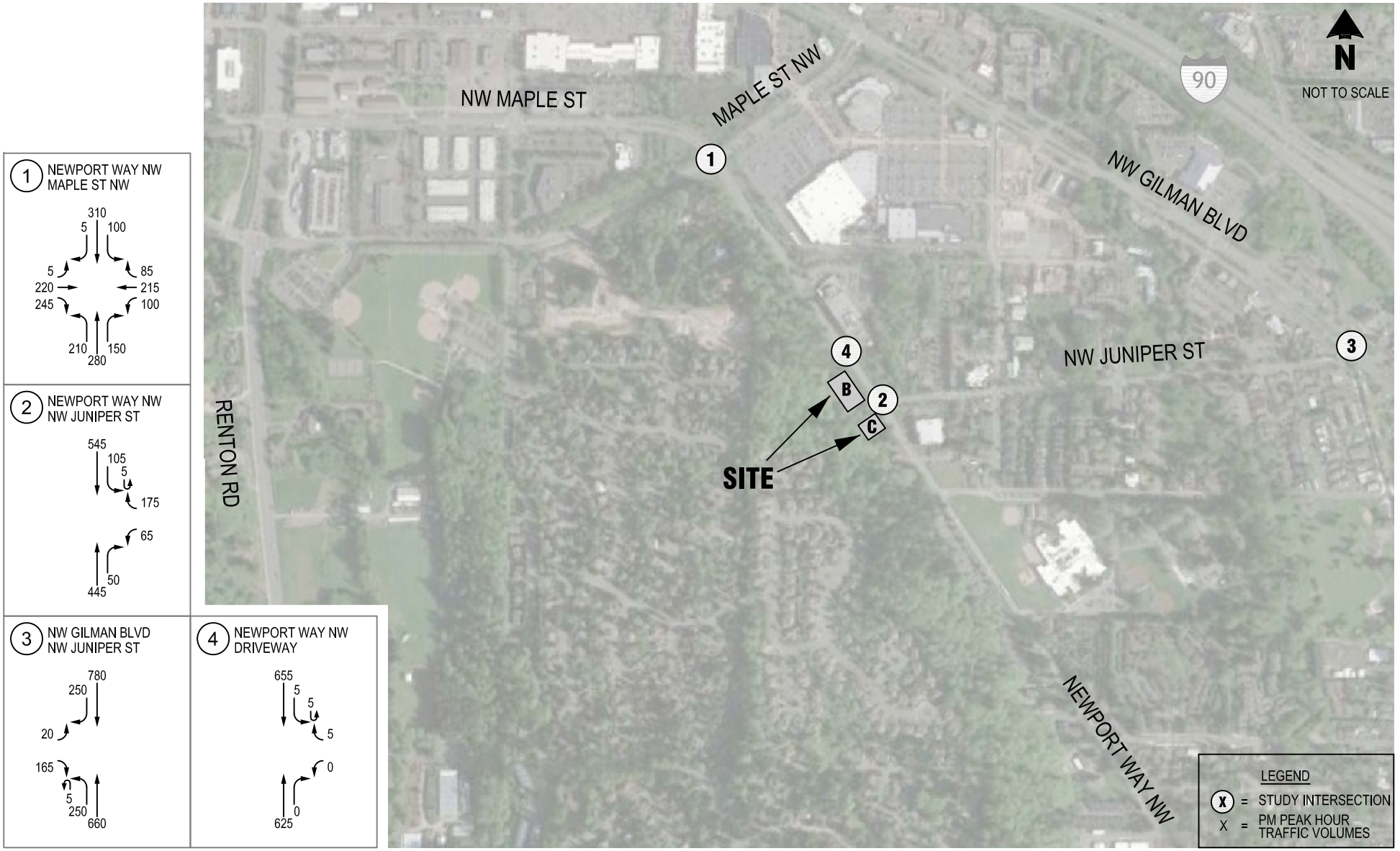
Existing (2015) Weekday PM Peak Hour Traffic Volumes

FIGURE 4

Inneswood Apartments

transpogroup
WHAT TRANSPORTATION CAN BE.

Dec 02, 2015 - 10:11am francescal \\srv-dfs-wa\MM_Projects\Projects\15\15036.00 - Inneswood Apts-Newport Road Improvements\Graphics\15036_Graphics.dwg Layout: 4 - Existing Volumes



Future (2018) Without-Project PM Peak Hour Traffic Volumes

FIGURE 5

Inneswood Apartments

transpogroup
WHAT TRANSPORTATION CAN BE.

Dec 02, 2015 - 10:12am francescal \\srv-dfs-wa\MM_Projects\Projects\15\15036.00 - Inneswood Apts-Newport Road Improvements\Graphics\15036_Graphics.dwg Layout: 5 - Future Without Proj

Traffic Safety

Recent collision records were reviewed within the study area to identify existing traffic safety issues at the study intersections. The most recent five-year summary of accident data from the Washington Department of Transportation (WSDOT) is for the period between January 1, 2010 and December 31, 2014. This information is summarized in Table 4.

Table 4. Five Year Collision Summary

Intersection	Traffic Control	Number of Collisions					Total	Annual Average
		2010	2011	2012	2013	2014		
1. Newport Way NW/NW Maple Street	Signalized	1	0	1	1	2	5	1.00
2. Newport Way NW/NW Juniper Street	Unsignalized	0	0	2	1	1	4	0.80
3. NW Gilman Boulevard/NW Juniper Street	Unsignalized	6	2	2	7	3	20	4.00
4. Newport Way NW/Library Access	Unsignalized	0	0	0	0	1	1	0.20

Source: WSDOT and Transpo Group, 2015

As shown in Table 4, the study intersections experienced an average of approximately 4 collisions or less. Of the 29 collisions no pedestrian, bicycle, or fatalities were reported.

Additionally, the high accident locations (HAL) were reviewed. The following are identified as HALs in the study area:

- The Newport Way NW/Maple Street NW intersection.
- NW Juniper Street from Rainier Boulevard N to Newport Way NW.
- Newport Way NW between Maple Street NW and W Sunset Way.

Potential project's impacts to the HALs is identified in a following section.

Non-Motorized Facilities

The following describes the existing and future non-motorized facilities within the study area.

Existing

Sidewalks are provided along the nearby streets with crosswalks located at signalized intersections. Crosswalks are also provided on the westbound leg of the Newport Way NW/NW Juniper Street and the eastbound approach of the NW Gilman Boulevard/NW Juniper Street intersection. Bicycle lanes are provided along NW Gilman Boulevard south of the Maple Street NW intersection. There are multi-use paths present along the north side of NW Maple Street and the north side of NW Juniper Street, north of the King County Library.

Future

Based on a review of the *City of Issaquah 2015-2020 Six Year Transportation Improvement Program (TIP)*, no transportation projects that may impact non-motorized facilities in the study area were identified to be completed by 2018. Although anticipated to be completed after the proposed project, safety improvements are planned at the Newport Way NW/ Maple Street NW intersection and along Newport Way NW. These include improvements to pedestrian and bicycle facilities, focusing on areas adjacent to the nearby elementary school.

Transit Service

The following sections describe existing and future transit service within the study area.

Existing

The existing Issaquah Transit Center, located just west of the study area, is served by five King Count Metro and three Sound Transit routes, providing access throughout Issaquah and the surrounding area. The service areas, operating hours, and headways are summarized in Table 5.

Table 5. Existing Transit Service

Routes	Area Served	Approximate Operating Hours	PM Peak Headways (minutes)
200	Downtown Issaquah – North Issaquah	9:00 a.m. to 3:00 p.m.	15-20
208	Issaquah – North Bend	5:00 a.m. to 9:30 p.m.	120
214	Issaquah – Downtown Seattle	5:00 a.m. to 9:30 a.m.; 3:00 p.m. to 7:00 p.m.	20
269	Issaquah – Overlake	6:00 a.m. to 8:00 p.m.	15-20
271	Issaquah – Bellevue, University District	5:00 a.m. to 11:30 p.m.	25-30
554[1]	Issaquah – Downtown Seattle	5:30 a.m. to 12:30 a.m.	20-30
555[1] 556[1]	Issaquah – Northgate[2]	5:00 a.m. to 7:30 p.m.	30

Source: King County Metro Transit and Sound Transit (2015).
1. This route is operated by Sound Transit.
2. Routes 555/556 service the same area; therefore, Sound Transit combines the route and schedule.

As shown in the table, most of the service is provided to the Seattle area and headways range from 15 to 30 minutes.

Future

No additional improvements are planned in the immediate vicinity of the proposed project to be completed before 2018.

Project Impacts

This section documents the proposed project's impacts on the surrounding street system and identifies potential mitigation measures where necessary.

Trip Generation

Weekday daily, AM, and PM peak hour trips were estimated for project-generated vehicle trips using average peak hour trip rates or regression equations for the proposed uses using information published by the Institute of Transportation Engineers (ITE) in *Trip Generation* (9th Edition, 2012). The proposed project would develop 81 apartment units and 12 townhome units. Trip generation was estimated based on the proposed Apartment (LU #220) and Residential Townhome (LU #230) land uses. The trip generation estimate also takes into account the removal of the existing Single-Family Home (LU #210). Trip generation for the proposed residential development is summarized in Table 6.

Table 6. Estimated Weekday Trip Generation

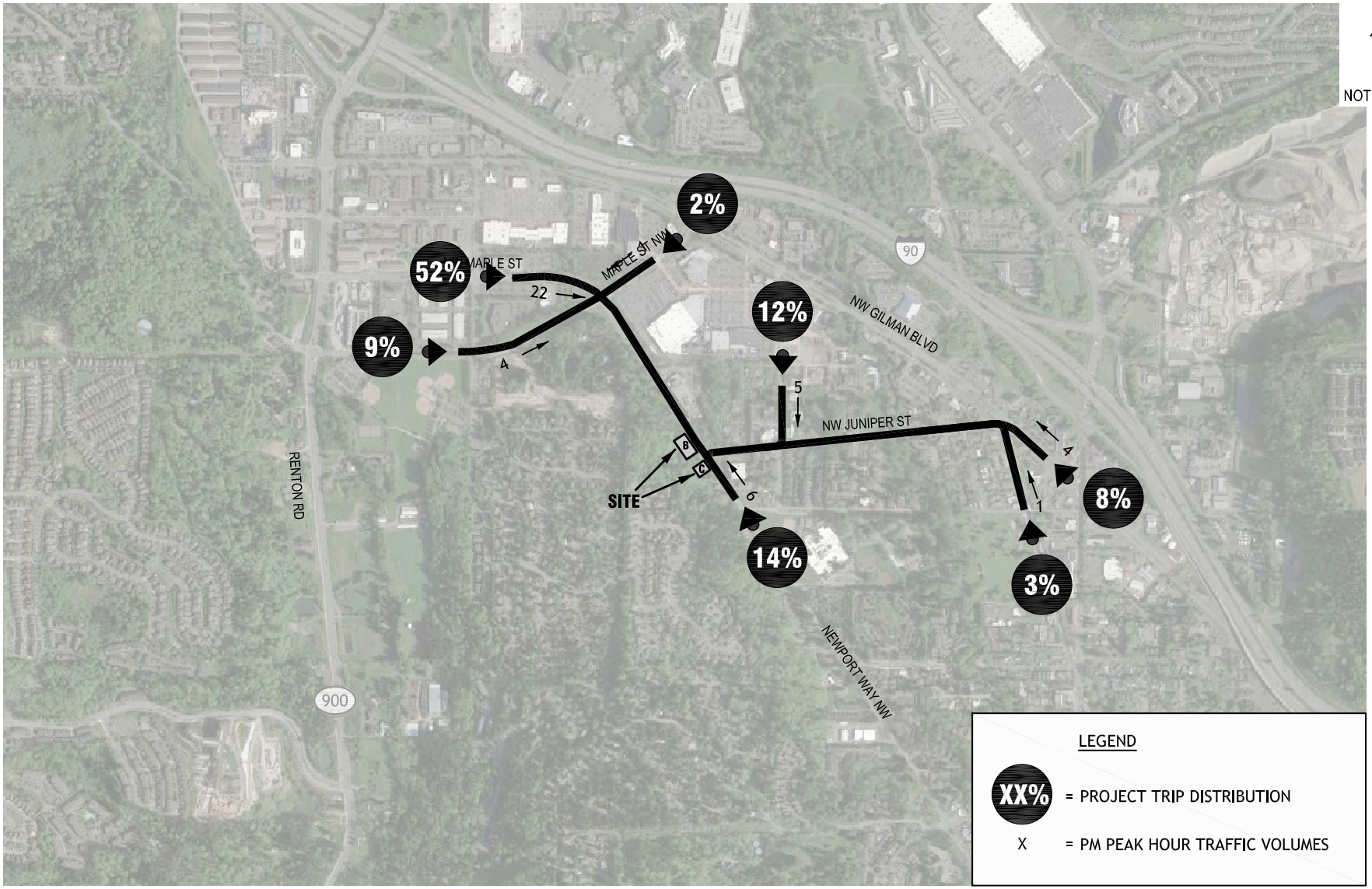
		Daily		AM Peak-Hour Trips				PM Peak-Hour Trips			
Land Use	**Size**	**Rate**	**Trips**	**Rate**	**In**	**Out**	**Total**	**Rate**	**In**	**Out**	**Total**
Proposed											
Apartment (LU #220)	81 du	EQ	614	EQ	9	34	43	EQ	40	22	62
Residential Townhome (LU #230)	12 du	5.81	70	0.44	1	4	5	0.52	4	2	6
Total			684		10	38	48		44	24	68
Existing											
Single Family Home (LU #210)	1 du	9.52	10	0.75	0	1	1	1.00	1	0	1
Net New Trips			**674**		**10**	**37**	**47**		**43**	**24**	**67**

du = dwelling unit

As shown in Table 6, the proposed project is anticipated to generate approximately 674 net new daily trips with 47 net new trips occurring during the weekday AM peak hour and 67 during the weekday PM peak hour.

Trip Distribution and Assignment

Travel patterns of the site generated vehicle traffic to and from the proposed site were based on the City of Issaquah travel demand model. Figure 6 illustrates the expected inbound trip distribution to the surrounding local and regional street system, Figure 7 illustrates the expected outbound trip distribution. An annual growth rate of 2 percent per year was applied to the existing PM peak hour traffic volumes at each study intersection to estimate future (2018) background traffic and the estimated trips were added to estimate future (2018) with-project weekday PM peak hour traffic volumes. These volumes are shown on Figure 8.

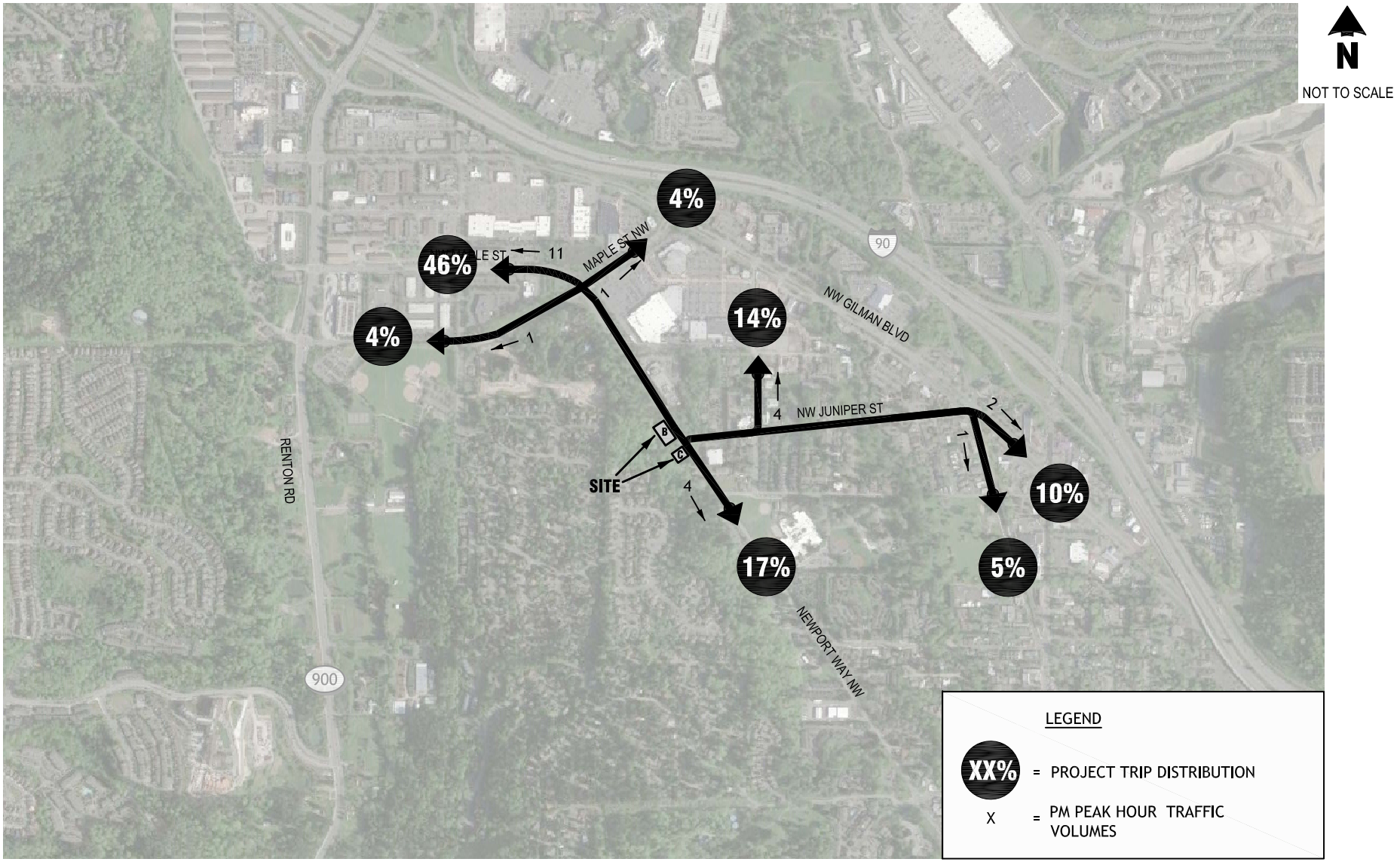


Preliminary Trip Distribution & Assignment - Inbound

Inneswood Apartments

FIGURE
6

transpogroup
WHAT TRANSPORTATION CAN BE.

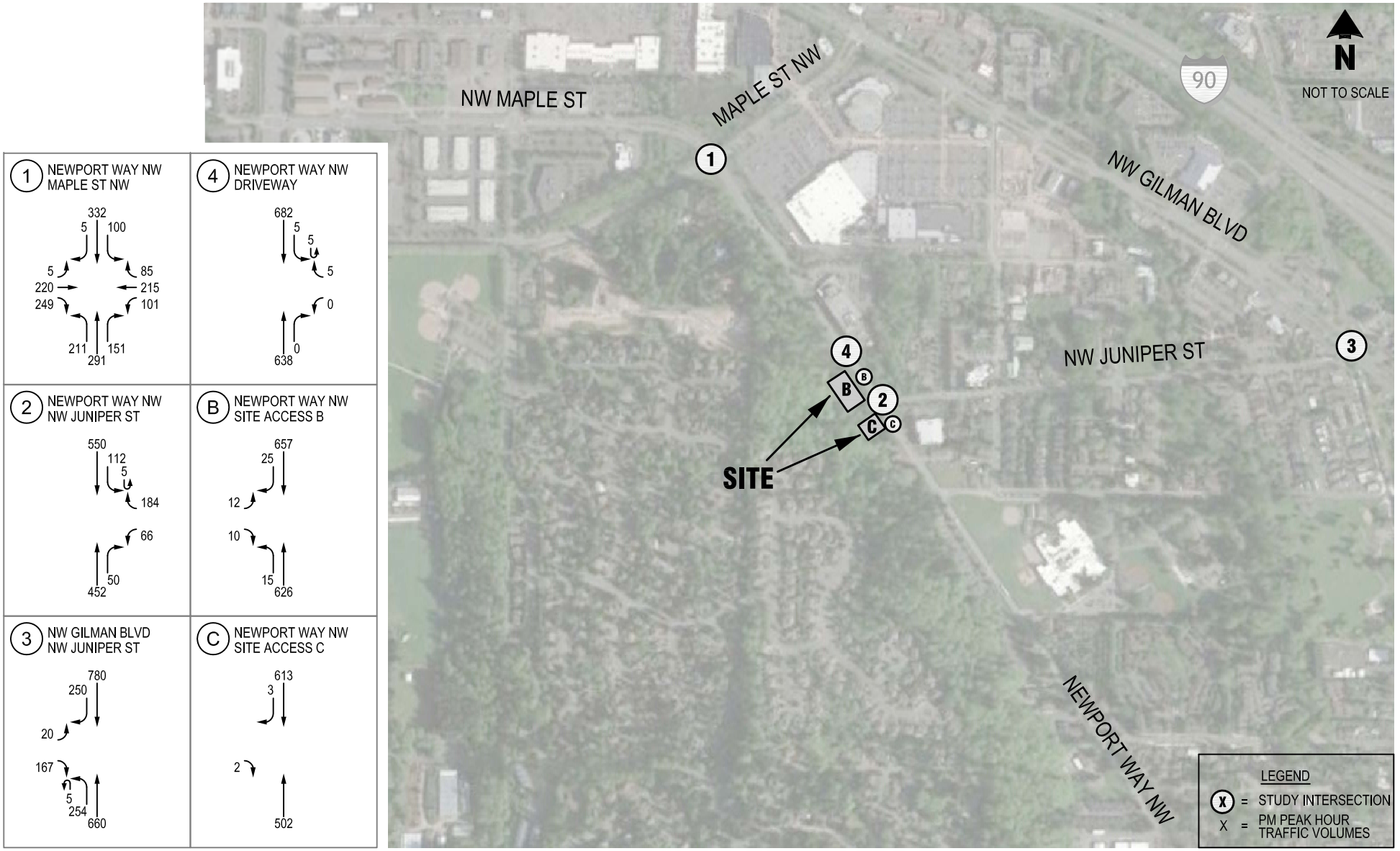


Preliminary Trip Distribution & Assignment - Outbound

FIGURE 7

Inneswood Apartments

transpogroup
WHAT TRANSPORTATION CAN BE.



Future (2018) With-Project PM Peak Hour Traffic Volumes

FIGURE 8

Inneswood Apartments

transpogroup
WHAT TRANSPORTATION CAN BE.

Traffic Operations Impact

Future (2018) with-project LOS analysis was conducted for the weekday PM peak hour to analyze traffic impacts of the proposed project. The same methods were applied as described for existing (2015) and future (2018) without-project conditions. All intersection parameters such as channelization and traffic control were consistent with those used in the evaluation of future without-project conditions with one exception. Under future (2018) with-project conditions, the Newport Way NW/NW Juniper Street intersection was evaluated as a roundabout. A comparison of future without- and with-project weekday PM peak hour traffic operations is summarized for the project site in Table 7. Detailed LOS worksheets are provided in Appendix C.

Table 7. Future Weekday PM Peak Hour Intersection LOS Summary

With a Roundabout Installed at the Newport Way NW/NW Juniper Street Intersection Under Future (2018) With-Project Conditions

Intersection	Traffic Control	2018 Without-Project PM			2018 With-Project PM		
		LOS[1]	Delay[2]	WM[3]	LOS	Delay	WM
1. Newport Way NW/NW Maple Street	Signalized	D	42	-	D	43	-
2. Newport Way NW/NW Juniper Street	Unsignalized	E	37	WB	A	7	WB
3. NW Gilman Boulevard/NW Juniper Street	Unsignalized	D	25	EB	D	26	EB
4. Newport Way NW/Library Access	Unsignalized	B	13	WB	B	13	WB
A. Newport Way NW/Site Access B	Unsignalized	-	-	-	C	16	EB
B. Newport Way NW/Site Access C	Unsignalized	-	-	-	B	13	EB

1. Level of Service (A – F) as defined by the 2010 *Highway Capacity Manual* (HCM), Transportation Research Board.
2. Average delay per vehicle in seconds.
3. WM = Worst Movement reported for unsignalized intersections. NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound.

As shown in Table 7, with the addition of project traffic, all study intersections are anticipated to operate at the same LOS as under future (2018) without-project conditions with the exception of the Newport Way NW/NW Juniper Street intersection. Overall impacts to the study intersections would generally be minimal with little to no change in calculated delays or LOS. The Newport Way NW/NW Juniper Street intersection is anticipated to improve from LOS E to LOS A with completion of the roundabout.

Site Access

Due to the proximity to the proposed roundabout at the Newport Way NW/NW Juniper Street intersection, site access C was evaluated as a right-in/right-out only driveway with a southbound right-turn lane extending from the roundabout at the Newport Way NW/NW Juniper Street intersection. It is anticipated that vehicles utilizing site access C with the desire to go north could turn right out of the site and utilize NW Holly Street and 7th Avenue NW to turn around and head north. Site access C is anticipated to operate at LOS B with approximately 13 seconds of delay.

Site access B was evaluated as a full access driveway and is anticipated to operate at LOS C with approximately 16 seconds of delay.

The Central Issaquah Development and Design Standards (CIDDS) does not specifically mention a minimum required driveway width. However, the City of Issaquah Department of Public Works Street Standards (Transportation, October 2010), Design Section B – Access Control (Driveways), Paragraph 6, Part A for Two-Way Driveways, does have a minimum as stated below:

> Two-Way Driveways: The minimum two-way driveway width shall be twelve feet (12') minimum and twenty feet (20') maximum for residential uses and twenty-four feet (24') minimum (can be reduced to twenty feet (20') under special circumstances approved by the City Engineer) and thirty-five feet (35') maximum for commercial uses. A wider commercial driveway width may be required by the Engineer where a substantial percentage of oversized vehicle traffic exists. In this case, the driveway should be sized to accommodate the largest vehicles. A maximum width of twenty-four feet (24') for driveways on designated pedestrian streets in Olde Town consistent with Olde Town Design Standards.

Since driveways for this project are for residential use, widths should not exceed 20 feet.

In addition, driveways should be constructed to meet Americans with Disability Act (ADA) requirements as shown in City of Issaquah Standard Detail T-05

In discussions with City staff, a concern was expressed regarding the proximity of Site Access B to the King County Library access located across Newport Way NW and slightly south from the Library access. The offset driveways have the potential of creating a conflict with opposing left-turning vehicles trying to enter the accesses at the same time. The southern access at the Library is not the main access, the main access is located to the north. Existing counts collected in November 2015 indicate that there were less than 10 vehicles utilizing the southern driveway. The counts indicate that less than 5 vehicles made a southbound left-turn into the Library access and less than 5 westbound right-turns out of the access, no westbound left-turning movements are indicated on the counts. The spacing between the two access is not adequate to provide dedicated left-turn lanes for both accesses. It is therefore recommended that the two-way left-turn lane be extended across both accesses to provide left-turn access to Building B and the King County Library.

Safety Analysis

The high accident locations (HAL) were reviewed. If 10 or more peak hour project trips are added to a HAL, the City considers this a probable significant adverse impact. The project is anticipated to add 10 or more peak hour trips to the following HALs with 10 or more peak hour trips:

- The Newport Way NW/Maple Street NW intersection.
- A section of NW Juniper Street from Newport Way NW to 7th Avenue NW. After 7th Avenue NW there are anticipated to be less than 10 peak hour project trips.
- A portion of Newport Way NW from NW Juniper Street to NW Holly Street. After NW Holly Street there are anticipated to be less than 10 peak hour project trips. The Section of Newport Way NW from NW Juniper Street to Maple Street NW.

As mentioned previously, the project is constructing improvements to the Newport Way NW/NW Juniper Street.

Additionally, no significant adverse safety impacts are anticipated given the following:

- Minor increase in traffic volumes at the study intersections. Traffic volume impacts are anticipated to be approximately 3 percent or less at the study intersection.
- Proposed construction of a roundabout at the Newport Way NW/NW Juniper Street.
- No notable increases in delay are anticipated at the study intersections, with the exception of the Newport Way NW/NW Juniper Street which will improve in operations assuming completion of a roundabout.
- Both site access locations are anticipated to operate at LOS C or better.

Parking Analysis

The following sections describe the proposed parking supply and parking code requirements.

Supply

Parking for the proposed project would be provided by 2 garages inclusive of 121 parking stalls. The Building B garage includes 113 stalls throughout 2 parking levels, 55 stalls on the lower level, and 58 stalls on the upper level. The Building C garage includes 8 stalls across 1 parking level. Both Building B and Building C garages include compact stalls, ADA accessible stalls, motorcycle parking, and bicycle parking.

Parking Code Analysis

The parking requirement for the proposed project is based on City of Issaquah Development and Design Standards. The City of Issaquah requires 1 space per unit for multifamily housing units. Figure 8 summarizes the parking requirements.

Table 8. Comparison of Code and Proposed Parking

Land Use	Size	Code Required Parking	Proposed Parking	
			Required	Provided
Building B				
Single Family Unit	12 units	1 space/unit	12	
Multifamily Studio Apartment	17 units	1 space/unit	17	
Multifamily Non-studio Apartment	57 units	1 space/unit	57	
Total			**86**	**113**
Building C				
Multifamily Non-studio Apartment	7 units	1 space/unit	7	
Total			**7**	**8**

Source: Development Standards: 8.0 Parking Standards.

As shown in Figure 8, the proposed development would include 81 residential apartment units and 12 residential townhome units. This results in a total of 93 required parking stalls. The project is proposing 121 parking stalls, which meets and exceeds parking requirements.

According to the CIDDS figure 6A, Auto Inclusive Circulation Facility Classification Map, this section of Newport Way NW is classified as a parkway. Per Section 6.4 Circulation Facility Classification Standards, Part H for Parkways, no on-street parking lanes are required. It should be noted that when parking lanes are required, such as for part F. Auto Inclusive Circulation Facilities: Core Streets, 8-foot lanes are required. The proposed parking lanes are 8-foot lanes.

Per Table 8.16-1, Computation of Loading Zones, a multi-family building of more than 40 units requires 2 Type A loading spaces. Per item 7 of Section 8.16, Type A Loading Space shall be at least 25 feet in depth and 10 feet in width, except that on-street loading spaces may be the width of adjacent parallel parking. Therefore, on-street loading spaces should be provided for Building B measuring 25 feet in depth and 8 feet in width, matching the proposed adjacent parallel parking.

Mitigation and Impact Fees

The project is planning to construct roadway improvements in the form of a roundabout at the Newport Way NW/NW Juniper Street intersection the cost of which will be credited toward the traffic impact fees.

Findings and Conclusions

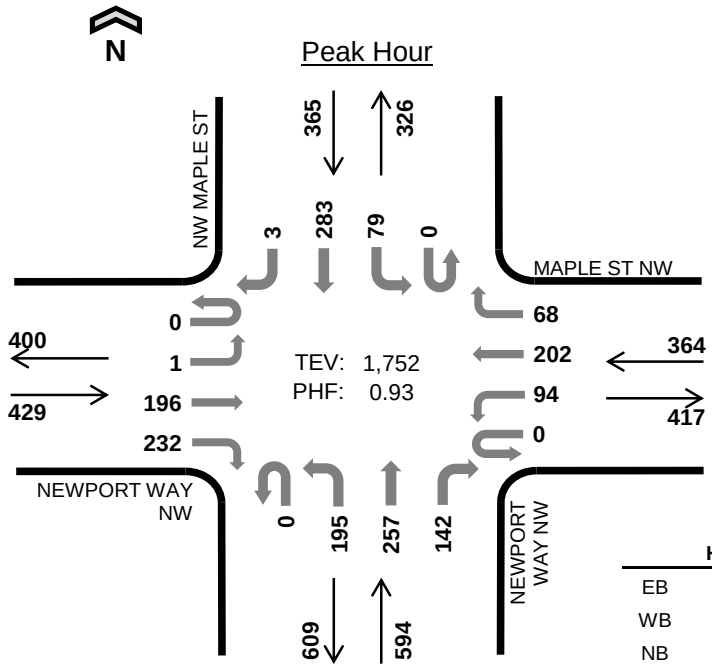
This transportation impact study summarizes the project traffic impacts of the proposed Inneswood Apartments residential development proposed along Newport Way NW. General findings and recommendations include:

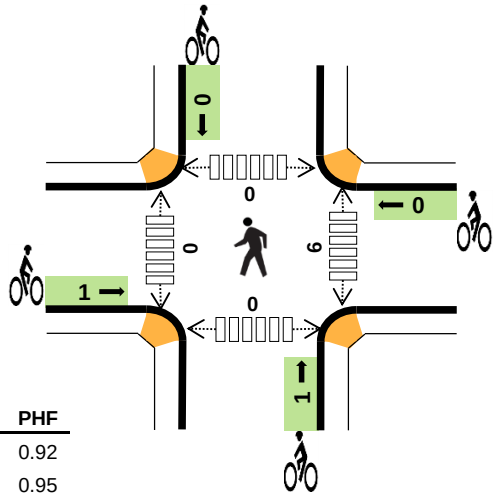
- The proposed project would develop 81 multi-family residential units and 12 townhomes.
- The project is anticipated to generate approximately 674 weekday daily trips with 47 occurring during the weekday AM peak hour and 67 during the PM peak hour.
- As part of the project it is planned that a roundabout would be constructed at the Newport Way NW/NW Juniper Street intersection.
- All study intersections currently operate at LOS D or better. Under future (2018) without-project conditions the Newport Way NW/NW Juniper Street intersection is anticipated to degrade from LOS C to LOS E and the NW Gilman Boulevard/NW Juniper Street intersection is anticipated to degrade from LOS C to LOS D. Under future (2018) with-project conditions, including construction of the proposed roundabout, the Newport Way NW/NW Juniper Street intersection is anticipated to improve to LOS A. The remaining intersections are anticipated to operate at the same LOS as under future without-project conditions.
- Site access B was evaluated as a full access driveway and is anticipated to operate at LOS C. Site access C was evaluated as a right-in/right-out only driveway and is anticipated to operate at LOS B. It is anticipated that vehicles utilizing site access C with the desire to go north could turn right out of the site and utilize NW Holly Street and 7th Avenue NW to turn around and head north.
- The proposed project plans to construct the proposed roundabout. In doing so, the project will receive credit toward the traffic impact fees.

Appendix A: Traffic Counts

NEWPORT WAY NW
MAPLE ST NW

Date: Tue, Nov 10, 2015
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:45 PM to 5:45 PM





	HV %:	PHF
EB	0.5%	0.92
WB	1.1%	0.95
NB	1.3%	0.85
SB	1.6%	0.91
TOTAL	1.1%	0.93

Two-Hour Count Summaries

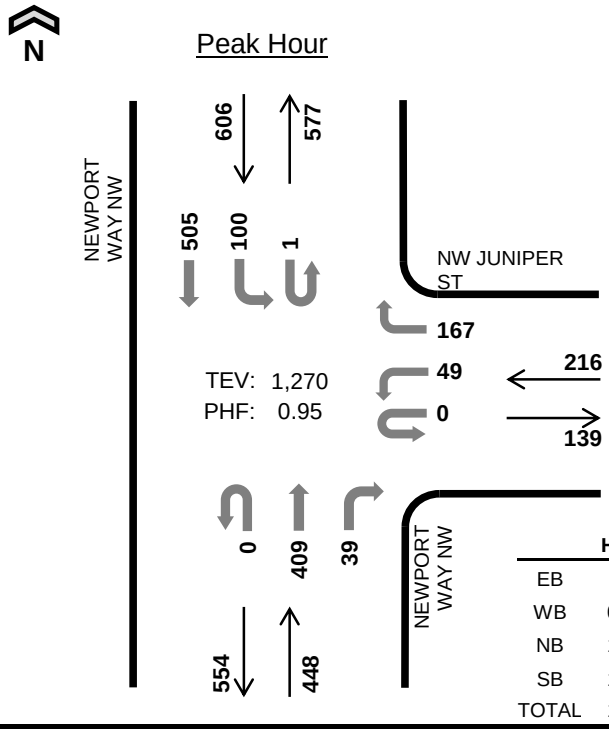
Interval Start	NEWPORT WAY NW Eastbound				MAPLE ST NW Westbound				NEWPORT WAY NW Northbound				NW MAPLE ST Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	0	47	42	0	21	65	24	0	47	53	20	0	13	83	0	415	0
4:15 PM	0	1	30	37	0	18	50	22	0	38	56	21	0	29	75	1	378	0
4:30 PM	0	5	40	64	0	29	45	14	0	42	55	26	0	16	68	0	404	0
4:45 PM	**0**	**0**	**38**	**52**	**0**	**25**	**49**	**19**	**0**	**44**	**59**	**46**	**0**	**18**	**73**	**0**	**423**	1,620
5:00 PM	**0**	**0**	**53**	**61**	**0**	**23**	**49**	**12**	**0**	**52**	**92**	**31**	**0**	**25**	**74**	**1**	**473**	1,678
5:15 PM	**0**	**1**	**58**	**57**	**0**	**26**	**51**	**19**	**0**	**59**	**58**	**29**	**0**	**22**	**70**	**0**	**450**	1,750
5:30 PM	**0**	**0**	**47**	**62**	**0**	**20**	**53**	**18**	**0**	**40**	**48**	**36**	**0**	**14**	**66**	**2**	**406**	**1,752**
5:45 PM	0	3	44	52	0	31	39	21	0	35	36	26	0	14	61	1	363	1,692
Count Total	0	10	357	427	0	193	401	149	0	357	457	235	0	151	570	5	3,312	0
Peak Hour	**0**	**1**	**196**	**232**	**0**	**94**	**202**	**68**	**0**	**195**	**257**	**142**	**0**	**79**	**283**	**3**	**1,752**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

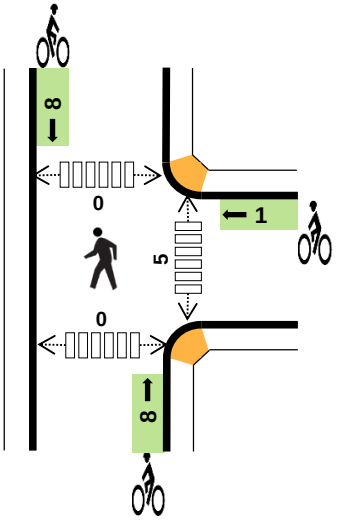
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	1	7	5	*13*	1	0	0	0	*1*	0	0	0	0	*0*
4:15 PM	1	3	1	3	*8*	1	0	0	0	*1*	0	0	2	2	*4*
4:30 PM	3	0	2	1	*6*	0	1	0	0	*1*	3	0	4	1	*8*
4:45 PM	**2**	**0**	**0**	**0**	***2***	**1**	**0**	**1**	**0**	***2***	**0**	**0**	**0**	**0**	*0*
5:00 PM	**0**	**1**	**2**	**3**	***6***	**0**	**0**	**0**	**0**	***0***	**2**	**0**	**0**	**0**	*2*
5:15 PM	**0**	**2**	**4**	**1**	***7***	**0**	**0**	**0**	**0**	***0***	**4**	**0**	**0**	**0**	*4*
5:30 PM	**0**	**1**	**2**	**2**	***5***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
5:45 PM	0	2	1	3	*6*	0	0	0	0	*0*	1	0	0	1	*2*
Count Total	6	10	19	18	*53*	3	1	1	0	*5*	10	0	6	4	*20*
Peak Hour	**2**	**4**	**8**	**6**	***20***	**1**	**0**	**1**	**0**	***2***	**6**	**0**	**0**	**0**	***6***

NEWPORT WAY NW
NW JUNIPER ST

Date: Tue, Nov 10, 2015
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:45 PM to 5:45 PM



	HV %:	PHF
EB	-	-
WB	0.5%	0.87
NB	1.8%	0.94
SB	1.3%	0.93
TOTAL	1.3%	0.95



Two-Hour Count Summaries

Interval Start	0				NW JUNIPER ST				NEWPORT WAY NW				NEWPORT WAY NW				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	0	0	0	0	13	0	36	0	0	91	8	0	7	138	0	293	0
4:15 PM	0	0	0	0	0	14	0	28	0	0	84	11	0	12	129	0	278	0
4:30 PM	0	0	0	0	0	11	0	39	0	0	77	9	0	18	145	0	299	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**42**	**0**	**0**	**107**	**10**	**1**	**31**	**106**	**0**	**311**	1,181
5:00 PM	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**54**	**0**	**0**	**106**	**13**	**0**	**29**	**124**	**0**	**334**	1,222
5:15 PM	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**32**	**0**	**0**	**111**	**8**	**0**	**24**	**139**	**0**	**324**	1,268
5:30 PM	**0**	**0**	**0**	**0**	**0**	**17**	**0**	**39**	**0**	**0**	**85**	**8**	**0**	**16**	**136**	**0**	**301**	**1,270**
5:45 PM	0	0	0	0	0	6	0	23	0	0	68	7	0	13	122	0	239	1,198
Count Total	0	0	0	0	0	93	0	293	0	0	729	74	1	150	1,039	0	2,379	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**49**	**0**	**167**	**0**	**0**	**409**	**39**	**1**	**100**	**505**	**0**	**1,270**	**0**

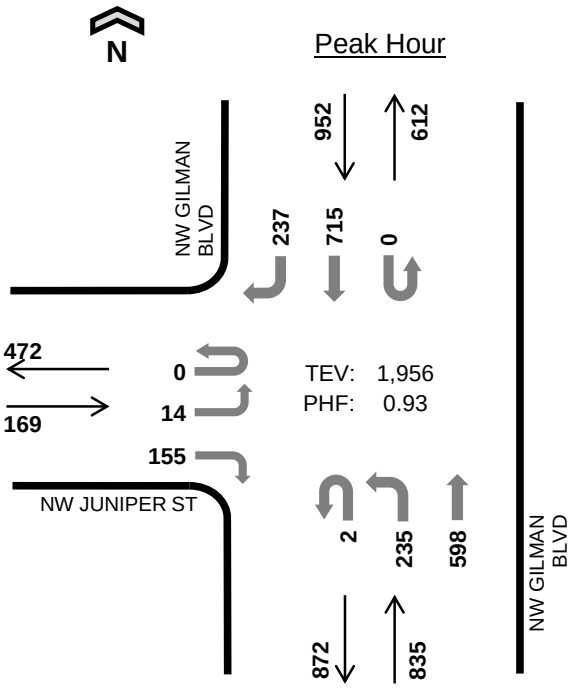
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

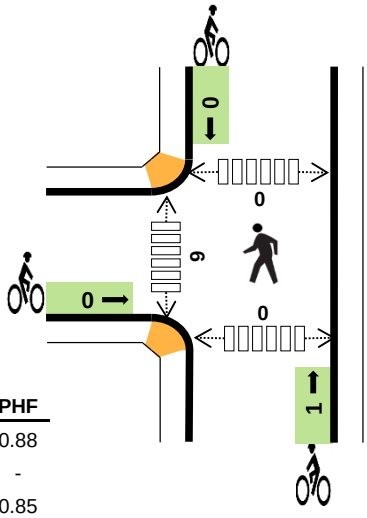
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	2	5	8	*15*	0	0	0	1	*1*	0	0	0	0	*0*
4:15 PM	0	0	1	2	*3*	0	0	0	2	*2*	0	0	0	0	*0*
4:30 PM	0	0	1	2	*3*	0	0	0	1	*1*	1	0	0	0	*1*
4:45 PM	**0**	**0**	**1**	**0**	***1***	**0**	**1**	**0**	**0**	***1***	**1**	**0**	**0**	**0**	*1*
5:00 PM	**0**	**0**	**2**	**5**	***7***	**0**	**0**	**0**	**0**	***0***	**3**	**0**	**0**	**0**	*3*
5:15 PM	**0**	**1**	**3**	**1**	***5***	**0**	**0**	**0**	**1**	***1***	**1**	**0**	**0**	**0**	*1*
5:30 PM	**0**	**0**	**2**	**2**	***4***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
5:45 PM	0	0	1	2	*3*	0	0	0	0	*0*	1	0	0	0	*1*
Count Total	0	3	16	22	*41*	0	1	0	5	*6*	7	0	0	0	*7*
Peak Hr	**0**	**1**	**8**	**8**	***17***	**0**	**1**	**0**	**1**	***2***	**5**	**0**	**0**	**0**	***5***

Mark Skaggs: (425) 250-0777 mark.skaggs@idaxdata.com

NW GILMAN BLVD
NW JUNIPER ST

Date: Tue, Nov 10, 2015
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:30 PM to 5:30 PM





	HV %:	PHF
EB	0.0%	0.88
WB	-	-
NB	1.2%	0.85
SB	0.6%	0.91
TOTAL	0.8%	0.93

Two-Hour Count Summaries

Interval Start	NW JUNIPER ST				0				NW GILMAN BLVD				NW GILMAN BLVD				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	11	0	42	0	0	0	0	0	36	152	0	0	0	178	60	479	0
4:15 PM	0	10	0	25	0	0	0	0	0	34	153	0	0	0	178	63	463	0
4:30 PM	**0**	**6**	**0**	**31**	**0**	**0**	**0**	**0**	**1**	**49**	**151**	**0**	**0**	**0**	**167**	**59**	**464**	0
4:45 PM	**0**	**2**	**0**	**46**	**0**	**0**	**0**	**0**	**0**	**65**	**133**	**0**	**0**	**0**	**152**	**67**	**465**	1,871
5:00 PM	**0**	**2**	**0**	**44**	**0**	**0**	**0**	**0**	**1**	**52**	**138**	**0**	**0**	**0**	**203**	**59**	**499**	1,891
5:15 PM	**0**	**4**	**0**	**34**	**0**	**0**	**0**	**0**	**0**	**69**	**176**	**0**	**0**	**0**	**193**	**52**	**528**	**1,956**
5:30 PM	0	8	0	40	0	0	0	0	0	27	129	0	0	0	172	47	423	1,915
5:45 PM	0	4	0	32	0	0	0	0	0	9	130	0	0	0	154	51	380	1,830
Count Total	0	47	0	294	0	0	0	0	2	341	1,162	0	0	0	1,397	458	3,701	0
Peak Hour	**0**	**14**	**0**	**155**	**0**	**0**	**0**	**0**	**2**	**235**	**598**	**0**	**0**	**0**	**715**	**237**	**1,956**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	2	0	3	2	*7*	1	0	0	0	*1*	0	4	0	0	*4*
4:15 PM	0	0	0	5	*5*	1	0	0	0	*1*	0	2	0	0	*2*
4:30 PM	**0**	**0**	**2**	**3**	***5***	**0**	**0**	**0**	**0**	***0***	**0**	**3**	**0**	**0**	*3*
4:45 PM	**0**	**0**	**1**	**1**	***2***	**0**	**0**	**1**	**0**	***1***	**0**	**6**	**0**	**0**	*6*
5:00 PM	**0**	**0**	**3**	**1**	***4***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
5:15 PM	**0**	**0**	**4**	**1**	***5***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
5:30 PM	0	0	3	0	*3*	0	0	0	0	*0*	0	0	0	0	*0*
5:45 PM	0	0	1	1	*2*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	2	0	17	14	*33*	2	0	1	0	*3*	0	15	0	0	*15*
Peak Hr	**0**	**0**	**10**	**6**	***16***	**0**	**0**	**1**	**0**	***1***	**0**	**9**	**0**	**0**	***9***

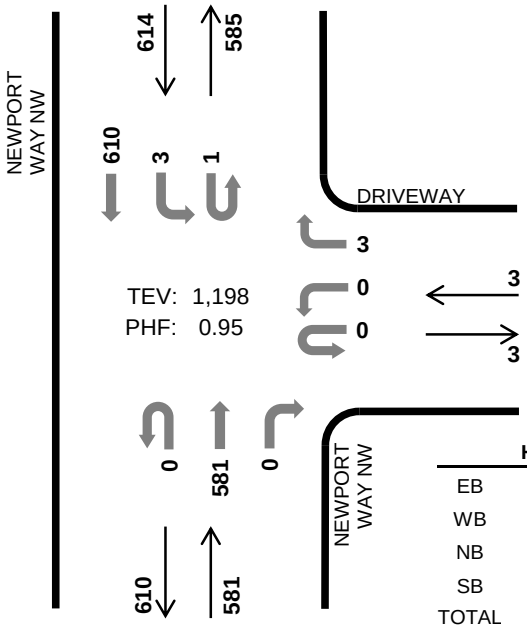
Mark Skaggs: (425) 250-0777 mark.skaggs@idaxdata.com

NEWPORT WAY NW
DRIVEWAY

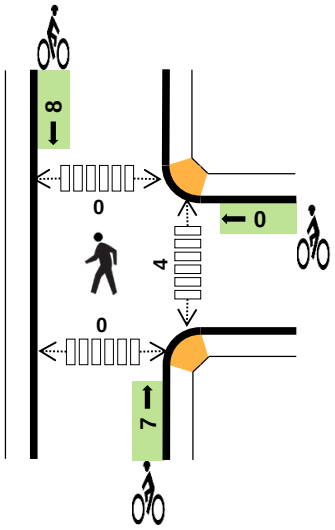
Date: Tue, Nov 10, 2015
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:45 PM to 5:45 PM

N

Peak Hour



	HV %:	PHF
EB	-	-
WB	0.0%	0.38
NB	1.2%	0.90
SB	1.3%	0.98
TOTAL	1.3%	0.95



Two-Hour Count Summaries

Interval Start	0				DRIVEWAY				NEWPORT WAY NW				NEWPORT WAY NW				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	0	0	0	0	1	0	1	0	0	128	0	0	0	146	0	276	0
4:15 PM	0	0	0	0	0	2	0	0	0	0	110	1	0	0	137	0	250	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	118	0	0	0	161	0	279	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**152**	**0**	**1**	**2**	**145**	**0**	**302**	1,107
5:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**162**	**0**	**0**	**0**	**154**	**0**	**316**	1,147
5:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**143**	**0**	**0**	**0**	**156**	**0**	**300**	1,197
5:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**124**	**0**	**0**	**1**	**155**	**0**	**280**	**1,198**
5:45 PM	0	0	0	0	0	0	0	0	0	0	91	0	1	0	137	0	229	1,125
Count Total	0	0	0	0	0	3	0	4	0	0	1,028	1	2	3	1,191	0	2,232	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**581**	**0**	**1**	**3**	**610**	**0**	**1,198**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	0	7	5	*12*	0	0	0	1	*1*	1	0	0	0	*1*
4:15 PM	0	0	1	2	*3*	0	0	0	2	*2*	0	0	0	0	*0*
4:30 PM	0	0	1	2	*3*	0	0	0	1	*1*	3	0	0	0	*3*
4:45 PM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**1**	**1**	***2***	**1**	**0**	**0**	**0**	*1*
5:00 PM	**0**	**0**	**2**	**3**	***5***	**0**	**0**	**0**	**0**	***0***	**2**	**0**	**0**	**0**	*2*
5:15 PM	**0**	**0**	**3**	**1**	***4***	**0**	**0**	**0**	**1**	***1***	**1**	**0**	**0**	**0**	*1*
5:30 PM	**0**	**0**	**2**	**3**	***5***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
5:45 PM	0	0	1	2	*3*	0	0	0	0	*0*	1	0	0	0	*1*
Count Total	0	0	17	19	*36*	0	0	1	6	*7*	9	0	0	0	*9*
Peak Hr	**0**	**0**	**7**	**8**	***15***	**0**	**0**	**1**	**2**	***3***	**4**	**0**	**0**	**0**	***4***

Appendix B: LOS Definitions

Highway Capacity Manual, 2000

Signalized intersection level of service (LOS) is defined in terms of the average total vehicle delay of all movements through an intersection. Vehicle delay is a method of quantifying several intangible factors, including driver discomfort, frustration, and lost travel time. Specifically, LOS criteria are stated in terms of average delay per vehicle during a specified time period (for example, the PM peak hour). Vehicle delay is a complex measure based on many variables, including signal phasing (i.e., progression of movements through the intersection), signal cycle length, and traffic volumes with respect to intersection capacity. Table 1 shows LOS criteria for signalized intersections, as described in the *Highway Capacity Manual* (Transportation Research Board, Special Report 209, 2000).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (sec/veh)	General Description (Signalized Intersections)
A	≤10	Free Flow
B	>10 - 20	Stable Flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report 209, 2000.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop-controlled and two-way stop-controlled. All-way, stop-controlled intersection LOS is expressed in terms of the average vehicle delay of all of the movements, much like that of a signalized intersection. Two-way, stop-controlled intersection LOS is defined in terms of the average vehicle delay of an individual movement(s). This is because the performance of a two-way, stop-controlled intersection is more closely reflected in terms of its individual movements, rather than its performance overall. For this reason, LOS for a two-way, stop-controlled intersection is defined in terms of its individual movements. With this in mind, total average vehicle delay (i.e., average delay of all movements) for a two-way, stop-controlled intersection should be viewed with discretion. Table 2 shows LOS criteria for unsignalized intersections (both all-way and two-way, stop-controlled).

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (sec/veh)
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report 209, 2000.

Highway Capacity Manual 2010

Signalized intersection level of service (LOS) is defined in terms of a weighted average control delay for the entire intersection. Control delay quantifies the increase in travel time that a vehicle experiences due to the traffic signal control as well as provides a surrogate measure for driver discomfort and fuel consumption. Signalized intersection LOS is stated in terms of average control delay per vehicle (in seconds) during a specified time period (e.g., weekday PM peak hour). Control delay is a complex measure based on many variables, including signal phasing and coordination (i.e., progression of movements through the intersection and along the corridor), signal cycle length, and traffic volumes with respect to intersection capacity and resulting queues. Table 1 summarizes the LOS criteria for signalized intersections, as described in the *Highway Capacity Manual 2010* (Transportation Research Board, 2010).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)	General Description
A	≤10	Free Flow
B	>10 – 20	Stable Flow (slight delays)
C	>20 – 35	Stable flow (acceptable delays)
D	>35 – 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 – 80	Unstable flow (intolerable delay)
F[1]	>80	Forced flow (congested and queues fail to clear)

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio for a lane group exceeds 1.0 LOS F is assigned to the individual lane group. LOS for overall approach or intersection is determined solely by the control delay.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop and two-way stop control. All-way stop control intersection LOS is expressed in terms of the weighted average control delay of the overall intersection or by approach. Two-way stop-controlled intersection LOS is defined in terms of the average control delay for each minor-street movement (or shared movement) as well as major-street left-turns. This approach is because major-street through vehicles are assumed to experience zero delay, a weighted average of all movements results in very low overall average delay, and this calculated low delay could mask deficiencies of minor movements. Table 2 shows LOS criteria for unsignalized intersections.

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F[1]	>50

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio exceeds 1.0, LOS F is assigned an individual lane group for all unsignalized intersections, or minor street approach at two-way stop-controlled intersections. Overall intersection LOS is determined solely by control delay.

Appendix C: LOS Worksheets

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	195	230	95	200	70	195	255	140	80	285	5
Future Volume (vph)	5	195	230	95	200	70	195	255	140	80	285	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00	0.99	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt		1.00	0.85	1.00	0.96		1.00	0.95		1.00	1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1879	1578	1787	1808		1787	3338		1770	3531	
Flt Permitted		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1879	1578	1787	1808		1787	3338		1770	3531	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	5	210	247	102	215	75	210	274	151	86	306	5
RTOR Reduction (vph)	0	0	115	0	7	0	0	54	0	0	1	0
Lane Group Flow (vph)	0	215	132	102	283	0	210	371	0	86	310	0
Confl. Peds. (#/hr)									6	6		
Confl. Bikes (#/hr)			1						1			
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	2%	2%	2%
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4									
Actuated Green, G (s)		22.3	22.3	30.3	30.3		18.0	22.0		9.8	13.8	
Effective Green, g (s)		22.3	22.3	30.3	30.3		18.0	22.0		9.8	13.8	
Actuated g/C Ratio		0.21	0.21	0.29	0.29		0.17	0.21		0.09	0.13	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		6.0	6.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)		401	337	518	524		308	703		166	466	
v/s Ratio Prot		c0.11		0.06	c0.16		c0.12	0.11		0.05	c0.09	
v/s Ratio Perm			0.08									
v/c Ratio		0.54	0.39	0.20	0.54		0.68	0.53		0.52	0.67	
Uniform Delay, d1		36.5	35.2	27.9	31.2		40.5	36.6		45.1	43.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.3	2.1	0.9	4.0		4.9	0.3		1.1	2.8	
Delay (s)		39.7	37.4	28.7	35.1		45.4	36.9		46.2	45.9	
Level of Service		D	D	C	D		D	D		D	D	
Approach Delay (s)		38.5			33.5			39.7			45.9	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	39.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	104.4	Sum of lost time (s)	20.0
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		
Description: Newport Way NW/Maple St NW			

c Critical Lane Group

Intersection	
Int Delay, s/veh	4

Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Traffic Vol, veh/h	50	165	410	30	5	100	505
Future Vol, veh/h	50	165	410	30	5	100	505
Conflicting Peds, #/hr	5	5	0	5	0	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	-	0
Grade, %	0	-	0	-	-	-	0
Peak Hour Factor	95	95	95	95	95	95	95
Heavy Vehicles, %	1	1	2	2	1	1	1
Mvmt Flow	53	174	432	32	5	105	532

Major/Minor	Minor1		Major1		Major2		
Conflicting Flow All	1194	463	0	0	637	468	0
Stage 1	452	-	-	-	-	-	-
Stage 2	742	-	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	-	4.11	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	-	2.209	-
Pot Cap-1 Maneuver	207	601	-	-	-	1099	-
Stage 1	643	-	-	-	-	-	-
Stage 2	473	-	-	-	-	-	-
Platoon blocked, %			-	-			-
Mov Cap-1 Maneuver	205	596	-	-	~ -21	~ -21	-
Mov Cap-2 Maneuver	205	-	-	-	-	-	-
Stage 1	640	-	-	-	-	-	-
Stage 2	471	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	23.8	0	
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	413	+	-
HCM Lane V/C Ratio	-	-	0.548	-	-
HCM Control Delay (s)	-	-	23.8	-	-
HCM Lane LOS	-	-	C	-	-
HCM 95th %tile Q(veh)	-	-	3.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	15	155	5	235	600	715	235
Future Vol, veh/h	15	155	5	235	600	715	235
Conflicting Peds, #/hr	9	9	0	9	0	0	9
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	-	None	-	None
Storage Length	85	-	-	100	-	-	-
Veh in Median Storage, #	0	-	-	-	0	0	-
Grade, %	0	-	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93	93
Heavy Vehicles, %	0	0	1	1	1	1	1
Mvmt Flow	16	167	5	253	645	769	253

Major/Minor	Minor2	Major1				Major2	
Conflicting Flow All	1743	529	1188	1031	0	-	0
Stage 1	904	-	-	-	-	-	-
Stage 2	839	-	-	-	-	-	-
Critical Hdwy	6.8	6.9	6.42	4.12	-	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.51	2.21	-	-	-
Pot Cap-1 Maneuver	79	499	254	676	-	-	-
Stage 1	360	-	-	-	-	-	-
Stage 2	389	-	-	-	-	-	-
Platoon blocked, %					-	-	-
Mov Cap-1 Maneuver	78	492	633	633	-	-	-
Mov Cap-2 Maneuver	78	-	-	-	-	-	-
Stage 1	357	-	-	-	-	-	-
Stage 2	386	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.1	4.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	633	-	78	492	-	-
HCM Lane V/C Ratio	0.408	-	0.207	0.339	-	-
HCM Control Delay (s)	14.5	-	62.8	16	-	-
HCM Lane LOS	B	-	F	C	-	-
HCM 95th %tile Q(veh)	2	-	0.7	1.5	-	-

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Traffic Vol, veh/h	0	5	580	0	5	5	610
Future Vol, veh/h	0	5	580	0	5	5	610
Conflicting Peds, #/hr	4	4	0	4	0	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	-	0
Grade, %	0	-	0	-	-	-	0
Peak Hour Factor	95	95	95	95	95	95	95
Heavy Vehicles, %	0	0	1	1	1	1	1
Mvmt Flow	0	5	611	0	5	5	642

Major/Minor	Minor1		Major1		Major2		
Conflicting Flow All	1268	624	0	0	616	615	0
Stage 1	615	-	-	-	-	-	-
Stage 2	653	-	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	-	4.11	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	2.209	-
Pot Cap-1 Maneuver	188	489	-	-	-	970	-
Stage 1	543	-	-	-	-	-	-
Stage 2	522	-	-	-	-	-	-
Platoon blocked, %			-	-			-
Mov Cap-1 Maneuver	187	486	-	-	~	~	-
Mov Cap-2 Maneuver	187	-	-	-	-	-	-
Stage 1	541	-	-	-	-	-	-
Stage 2	520	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.5	0	
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	486	~	-
HCM Lane V/C Ratio	-	-	0.011	~	-
HCM Control Delay (s)	-	-	12.5	-	-
HCM Lane LOS	-	-	B	-	-
HCM 95th %tile Q(veh)	-	-	0	~	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	220	245	100	215	85	210	280	150	100	310	5
Future Volume (vph)	5	220	245	100	215	85	210	280	150	100	310	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00	0.99	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt		1.00	0.85	1.00	0.96		1.00	0.95		1.00	1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1879	1578	1787	1801		1787	3342		1770	3531	
Flt Permitted		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1879	1578	1787	1801		1787	3342		1770	3531	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	5	237	263	108	231	91	226	301	161	108	333	5
RTOR Reduction (vph)	0	0	108	0	8	0	0	50	0	0	1	0
Lane Group Flow (vph)	0	242	155	108	314	0	226	412	0	108	337	0
Confl. Peds. (#/hr)									6	6		
Confl. Bikes (#/hr)			1						1			
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	2%	2%	2%
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4									
Actuated Green, G (s)		24.1	24.1	30.2	30.2		19.8	23.8		11.2	15.2	
Effective Green, g (s)		24.1	24.1	30.2	30.2		19.8	23.8		11.2	15.2	
Actuated g/C Ratio		0.22	0.22	0.28	0.28		0.18	0.22		0.10	0.14	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		6.0	6.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)		414	347	493	497		323	727		181	491	
v/s Ratio Prot		c0.13		0.06	c0.17		c0.13	0.12		0.06	c0.10	
v/s Ratio Perm			0.10									
v/c Ratio		0.58	0.45	0.22	0.63		0.70	0.57		0.60	0.69	
Uniform Delay, d1		38.1	36.8	30.5	34.7		42.0	38.1		46.9	44.8	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.0	2.6	1.0	6.0		5.3	0.6		3.5	3.2	
Delay (s)		42.1	39.4	31.5	40.7		47.2	38.8		50.4	48.0	
Level of Service		D	D	C	D		D	D		D	D	
Approach Delay (s)		40.7			38.4			41.5			48.5	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	109.3	Sum of lost time (s)	20.0
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		

Description: Newport Way NW/Maple St NW

c Critical Lane Group

Intersection	
Int Delay, s/veh	6.3

Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Traffic Vol, veh/h	65	175	445	50	5	105	545
Future Vol, veh/h	65	175	445	50	5	105	545
Conflicting Peds, #/hr	5	5	0	5	0	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	-	0
Grade, %	0	-	0	-	-	-	0
Peak Hour Factor	95	95	95	95	95	95	95
Heavy Vehicles, %	1	1	2	2	1	1	1
Mvmt Flow	68	184	468	53	5	111	574

Major/Minor	Minor1		Major1		Major2		
Conflicting Flow All	1295	510	0	0	705	526	0
Stage 1	500	-	-	-	-	-	-
Stage 2	795	-	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	-	4.11	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	-	2.209	-
Pot Cap-1 Maneuver	180	565	-	-	-	1046	-
Stage 1	611	-	-	-	-	-	-
Stage 2	446	-	-	-	-	-	-
Platoon blocked, %			-	-			-
Mov Cap-1 Maneuver	179	560	-	-	~ -22	~ -22	-
Mov Cap-2 Maneuver	179	-	-	-	-	-	-
Stage 1	608	-	-	-	-	-	-
Stage 2	444	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	36.6	0	
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	355	+	-
HCM Lane V/C Ratio	-	-	0.712	-	-
HCM Control Delay (s)	-	-	36.6	-	-
HCM Lane LOS	-	-	E	-	-
HCM 95th %tile Q(veh)	-	-	5.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	20	165	5	250	660	780	250
Future Vol, veh/h	20	165	5	250	660	780	250
Conflicting Peds, #/hr	9	9	0	9	0	0	9
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	-	None	-	None
Storage Length	85	-	-	100	-	-	-
Veh in Median Storage, #	0	-	-	-	0	0	-
Grade, %	0	-	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93	93
Heavy Vehicles, %	0	0	1	1	1	1	1
Mvmt Flow	22	177	5	269	710	839	269

Major/Minor	Minor2	Major1				Major2	
Conflicting Flow All	1885	572	1285	1117	0	-	0
Stage 1	982	-	-	-	-	-	-
Stage 2	903	-	-	-	-	-	-
Critical Hdwy	6.8	6.9	6.42	4.12	-	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.51	2.21	-	-	-
Pot Cap-1 Maneuver	64	468	220	627	-	-	-
Stage 1	328	-	-	-	-	-	-
Stage 2	361	-	-	-	-	-	-
Platoon blocked, %					-	-	-
Mov Cap-1 Maneuver	63	461	583	583	-	-	-
Mov Cap-2 Maneuver	63	-	-	-	-	-	-
Stage 1	326	-	-	-	-	-	-
Stage 2	358	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	25.4	4.6	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	583	-	63	461	-	-
HCM Lane V/C Ratio	0.47	-	0.341	0.385	-	-
HCM Control Delay (s)	16.5	-	89.3	17.6	-	-
HCM Lane LOS	C	-	F	C	-	-
HCM 95th %tile Q(veh)	2.5	-	1.3	1.8	-	-

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Traffic Vol, veh/h	0	5	625	0	5	5	655
Future Vol, veh/h	0	5	625	0	5	5	655
Conflicting Peds, #/hr	4	4	0	4	0	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	-	0
Grade, %	0	-	0	-	-	-	0
Peak Hour Factor	95	95	95	95	95	95	95
Heavy Vehicles, %	0	0	1	1	1	1	1
Mvmt Flow	0	5	658	0	5	5	689

Major/Minor	Minor1		Major1		Major2		
Conflicting Flow All	1362	671	0	0	663	662	0
Stage 1	662	-	-	-	-	-	-
Stage 2	700	-	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	-	4.11	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	2.209	-
Pot Cap-1 Maneuver	165	460	-	-	-	931	-
Stage 1	517	-	-	-	-	-	-
Stage 2	496	-	-	-	-	-	-
Platoon blocked, %			-	-			-
Mov Cap-1 Maneuver	164	457	-	-	~	~	-
Mov Cap-2 Maneuver	164	-	-	-	-	-	-
Stage 1	515	-	-	-	-	-	-
Stage 2	494	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13	0	
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	457	~	-
HCM Lane V/C Ratio	-	-	0.012	~	-
HCM Control Delay (s)	-	-	13	-	-
HCM Lane LOS	-	-	B	-	-
HCM 95th %tile Q(veh)	-	-	0	~	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	220	249	101	215	85	211	291	151	100	332	5
Future Volume (vph)	5	220	249	101	215	85	211	291	151	100	332	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00	0.99	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt		1.00	0.85	1.00	0.96		1.00	0.95		1.00	1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1879	1578	1787	1801		1787	3347		1770	3532	
Flt Permitted		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1879	1578	1787	1801		1787	3347		1770	3532	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	5	237	268	109	231	91	227	313	162	108	357	5
RTOR Reduction (vph)	0	0	109	0	8	0	0	47	0	0	1	0
Lane Group Flow (vph)	0	242	159	109	314	0	227	428	0	108	361	0
Confl. Peds. (#/hr)									6	6		
Confl. Bikes (#/hr)			1						1			
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	2%	2%	2%
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4									
Actuated Green, G (s)		24.4	24.4	30.2	30.2		19.9	24.7		11.2	16.0	
Effective Green, g (s)		24.4	24.4	30.2	30.2		19.9	24.7		11.2	16.0	
Actuated g/C Ratio		0.22	0.22	0.27	0.27		0.18	0.22		0.10	0.14	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		6.0	6.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)		414	348	488	492		321	748		179	511	
v/s Ratio Prot		c0.13		0.06	c0.17		c0.13	0.13		0.06	c0.10	
v/s Ratio Perm			0.10									
v/c Ratio		0.58	0.46	0.22	0.64		0.71	0.57		0.60	0.71	
Uniform Delay, d1		38.5	37.3	31.1	35.3		42.6	38.2		47.5	45.0	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.0	2.7	1.1	6.2		5.7	0.7		3.9	3.6	
Delay (s)		42.5	40.0	32.1	41.6		48.3	38.9		51.4	48.6	
Level of Service		D	D	C	D		D	D		D	D	
Approach Delay (s)		41.2			39.2			41.9			49.3	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	110.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

Description: Newport Way NW/Maple St NW

c Critical Lane Group

MOVEMENT SUMMARY

Site: Newport Way NW/NW Juniper St

Future (2018) With-Project PM Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Newport Way NW											
8	T1	476	2.0	0.542	6.3	LOS A	4.6	116.6	0.52	0.54	35.2
18	R2	53	2.0	0.542	5.9	LOS A	4.6	116.6	0.52	0.54	34.4
Approach		528	2.0	0.542	6.2	LOS A	4.6	116.6	0.52	0.54	35.1
East: NW Juniper St											
1	L2	69	1.0	0.391	13.6	LOS B	2.5	62.1	0.73	0.83	33.8
16	R2	194	1.0	0.391	8.8	LOS A	2.5	62.1	0.73	0.83	33.1
Approach		263	1.0	0.391	10.1	LOS B	2.5	62.1	0.73	0.83	33.3
North: Newport Way NW											
7	L2	118	1.0	0.570	9.9	LOS A	5.9	147.7	0.43	0.49	35.1
4	T1	584	1.0	0.570	5.4	LOS A	5.9	147.7	0.43	0.49	35.2
Approach		702	1.0	0.570	6.2	LOS A	5.9	147.7	0.43	0.49	35.2
All Vehicles		1494	1.4	0.570	6.9	LOS A	5.9	147.7	0.52	0.57	34.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	20	167	5	254	660	780	250
Future Vol, veh/h	20	167	5	254	660	780	250
Conflicting Peds, #/hr	9	9	0	9	0	0	9
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	-	None	-	None
Storage Length	85	-	-	100	-	-	-
Veh in Median Storage, #	0	-	-	-	0	0	-
Grade, %	0	-	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93	93
Heavy Vehicles, %	0	0	1	1	1	1	1
Mvmt Flow	22	180	5	273	710	839	269

Major/Minor	Minor2		Major1			Major2	
Conflicting Flow All	1894	572	1287	1117	0	-	0
Stage 1	982	-	-	-	-	-	-
Stage 2	912	-	-	-	-	-	-
Critical Hdwy	6.8	6.9	6.42	4.12	-	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.51	2.21	-	-	-
Pot Cap-1 Maneuver	63	468	219	627	-	-	-
Stage 1	328	-	-	-	-	-	-
Stage 2	357	-	-	-	-	-	-
Platoon blocked, %					-	-	-
Mov Cap-1 Maneuver	62	461	583	583	-	-	-
Mov Cap-2 Maneuver	62	-	-	-	-	-	-
Stage 1	326	-	-	-	-	-	-
Stage 2	354	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	25.6	4.7	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	583	-	62	461	-	-
HCM Lane V/C Ratio	0.478	-	0.347	0.39	-	-
HCM Control Delay (s)	16.7	-	91.2	17.7	-	-
HCM Lane LOS	C	-	F	C	-	-
HCM 95th %tile Q(veh)	2.6	-	1.3	1.8	-	-

Intersection	
Int Delay, s/veh	0

Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Traffic Vol, veh/h	0	5	638	0	5	5	682
Future Vol, veh/h	0	5	638	0	5	5	682
Conflicting Peds, #/hr	4	4	0	4	0	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	-	None
Storage Length	0	-	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	-	0
Grade, %	0	-	0	-	-	-	0
Peak Hour Factor	95	95	95	95	95	95	95
Heavy Vehicles, %	0	0	1	1	1	1	1
Mvmt Flow	0	5	672	0	5	5	718

Major/Minor	Minor1		Major1		Major2		
Conflicting Flow All	1056	685	0	0	677	676	0
Stage 1	676	-	-	-	-	-	-
Stage 2	380	-	-	-	-	-	-
Critical Hdwy	6.6	6.2	-	-	-	4.11	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	2.209	-
Pot Cap-1 Maneuver	237	452	-	-	-	920	-
Stage 1	509	-	-	-	-	-	-
Stage 2	667	-	-	-	-	-	-
Platoon blocked, %			-	-			-
Mov Cap-1 Maneuver	235	449	-	-	~	~	-
Mov Cap-2 Maneuver	367	-	-	-	-	-	-
Stage 1	507	-	-	-	-	-	-
Stage 2	665	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.1	0	
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	449	~	-
HCM Lane V/C Ratio	-	-	0.012	~	-
HCM Control Delay (s)	-	-	13.1	-	-
HCM Lane LOS	-	-	B	-	-
HCM 95th %tile Q(veh)	-	-	0	~	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	12	10	15	626	657	25
Future Vol, veh/h	12	10	15	626	657	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	1	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	13	11	16	680	714	27

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1441	371	741	0	-	0
Stage 1	728	-	-	-	-	-
Stage 2	713	-	-	-	-	-
Critical Hdwy	6.63	6.93	4.14	-	-	-
Critical Hdwy Stg 1	5.83	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.22	-	-	-
Pot Cap-1 Maneuver	134	627	862	-	-	-
Stage 1	440	-	-	-	-	-
Stage 2	485	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	130	627	862	-	-	-
Mov Cap-2 Maneuver	267	-	-	-	-	-
Stage 1	440	-	-	-	-	-
Stage 2	470	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.7	0.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	862	-	361	-	-
HCM Lane V/C Ratio	0.019	-	0.066	-	-
HCM Control Delay (s)	9.3	0	15.7	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.2	-	-

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	0	2	0	502	613	3
Future Vol, veh/h	0	2	0	502	613	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	2	0	546	666	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1212	666	666	0	-	0
Stage 1	666	-	-	-	-	-
Stage 2	546	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	201	459	923	-	-	-
Stage 1	511	-	-	-	-	-
Stage 2	580	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	201	459	923	-	-	-
Mov Cap-2 Maneuver	201	-	-	-	-	-
Stage 1	511	-	-	-	-	-
Stage 2	580	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.9	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	923	-	459	-	-
HCM Lane V/C Ratio	-	-	0.005	-	-
HCM Control Delay (s)	0	-	12.9	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-